Generalization of a mixing-length model for nonradially pulsating stars

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Convection models based on the mixing-length approach still represent the main method for computing the turbulent fluxes in stars with convectively unstable layers. In such layers the pulsationally stability of the star is affected not only by the radiative heat flux but also by both the modulation of the convective heat flux and by direct mechanical coupling of the pulsation with the convective motion via the Reynolds stresses. Time-dependent formulations of the mixing-length approach for radial pulsation have been proposed for example, by Unno (1967) and Gough (1977). Using Gough's model Balmforth (1992) reported good agreement between theoretical damping rates of radial p modes of a solar model and observed linewidths.

In this contribution we discuss a generalization of Gough's time-dependent mixing-length formulation for nonradial pulsation. The pulsation is described by a time-dependent mean flow. The lateral component of this mean flow represents a shearing motion in the linearized fluctuation equations. The shearing motion stretches the convective elements and generates off-diagonal terms in the Reynolds stress tensor. In this description another parameter, additional to the mixing-length parameter, is introduced representing the angle between the lateral components of the mean flow and of the wave vector characterizing the convective element.